SWIMMING AND DIVING FLIPPERS FOR DISTRIBUTION OF FORCE

RELATED U.S. APPLICATIONS

Not applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

REFERENCE TO MICROFICHE APPENDIX

Not applicable.

FIELD OF THE INVENTION

[0001] The present invention concerns an effort-distributing swimming and diving flipper.

BACKGROUND OF THE INVENTION

[0002] Underwater swimming with flippers requires an alternating leg movement which practitioners have defined by the neologism as "finning". In this movement one distinguishes between an active, or propelling, phase and a passive phase.

[0003] The active phase requires significant muscular energy which is transmitted to the flipper so as to produce an action/reaction phenomenon with the water resulting in the propulsion of the swimmer. In the passive phase the expenditure of energy is small; it is a period of rest and preparation, the flipper returning, with a lesser propelling action, to the starting position of the active phase.

[0004] During the passive phase the movement consists of a bending of the hips resulting in a lowering of the thighs in the water, a bending of the knees and a re-straightening of the legs towards the vertical with a dorsal bending of the ankles. It would seem that during this passive period, only

the hip bending muscles (psoas, iliac, rectus femorias, tensor of fascia lata, small and medium gluteal, sartorius muscle, small and medium adductor, pectinated and gracilis muscle) act by causing all the passive leg movements.

[0005] During the active phase an extension of the knees occurs due to the common action of the quadriceps and the deltoid muscle as well as a hip extension by contraction of the gluteus maximus muscle, the long biceps, the semi-membranosus, semi-tendinosus muscles, the middle gluteal muscle, and the large adductor. Depending on the swimmer's outfit and in particular the additional mass of equipment he carries, as well as the length of the blade of the flippers, these simultaneous actions of bending and extension of hips and knees are more or less pronounced and always require a significant muscular effort.

[0006] The articles currently available on the market are generally designed after the flipper model that has been known for over thirty years, the most current of these articles consisting of a bootee of soft material to accommodate the foot and of a long or short blade of one or several more or less rigid material(s).

[0007] In all these models the swimmer's ankle is left completely free, so that the amplitude of the foot movements is established by the anatomical limits of the foot's articulation. Under these conditions the effort produced during finning is essentially borne by the swimmer's ankles, so much so that the abnormal prolonged demand made on them causes articular pain which is susceptible of generating tendinous pathologies as well as muscular leg pain (sural triceps) which can lead to cramps. Such pain appears usually during intensive use, while striving for power or amplitude in the movement, essentially during the active downward phase of the flipper; the articular pain arises from prolonged and repetitive utilization, activating muscular groups not much used to this type of effort.

[0008] In document US - 4.017.925 a swimming flipper was proposed which included: on the one hand, a bootee for accommodating a user's foot and extending in front in the form of a blade so as to constitute a mobile propulsion assembly, this bootee being shaped so as to permit, when positioned on the user's foot, a movement of the upper part of the foot or instep in relation to the leg, so that the instep can form, during the finning action, an angle of variable size during said action, and, on the other hand, a leg or sleeve fastening device shaped so that it can be fixed around the lower part of the leg and below the calf of a user and to be connected to the mobile propulsion assembly by the intermediary of lateral arms for effort transmission and through articulations, the lower extremities of these arms and said mobile propulsion assembly being fitted in a complementary manner so as to constitute limit stop systems ensuring, during the active phase of the finning movement, a limitation of the size of this angle in order to reduce the constraints sustained by the ankle in this movement.

[0009] However, according to the production method of the swimming flipper described in document US-4.017.925, the fulcrum pin of the propulsion assembly is located in back of the strip intended for wrapping the user's heel, so that when the flipper is in the use position, said fulcrum pin is located behind the heel and thus relatively away from the swimmer's malleoli. Positioning the fulcrum pin in the rear and at a distance from the malleoli results in a sliding phenomenon of the sleeve along the tibia during finning which rapidly causes lesions at the point of contact with the sleeve and makes it necessary to effect a strong, equally painful tightening and which eliminates any possibility of a twisting movement of the ankle.

BRIEF SUMMARY OF THE INVENTION

[0010] One objective of the present invention is to make available to persons practicing underwater sports and/or swimming a swimming and diving flipper devoid of the afore-mentioned

inconveniences, as this flipper is particularly capable of eliminating the occurrence of pain at the ankle by redistributing in a more homogeneous manner and over the entire leg, the effort produced by the action of the blade and by improving performance while maintaining comfort.

[0011] According to invention, this goal has been achieved owing to the swimming and diving flipper of the aforementioned kind, this swimming and diving flipper being remarkable because the lower extremities of the effort-transmitting arms are attached by hinges on the mobile propulsion assembly at points corresponding to the locations of the malleoli when the flipper is placed on a user's foot.

[0012] By providing the fulcrum pin of the propulsion assembly at the locations of the malleoli exceptional comfort is offered to the swimmer.

[0013] This allows also to eliminate the traumatizing grip pressure between the sleeve and the tibia and thus to enable a twisting movement of the ankle that is necessary for the twisting movements (sideways and backward displacements that are very frequent in the water).

[0014] With the claimed flipper, the foot maintains great freedom of movement, the blockage occurring only at maximum extension. This freedom is important because it allows the diver the same maneuverability as a traditional flipper.

[0015] Limiting the constraints on the ankle in connection with the forward movement of the flipper in its main propellant phase makes it possible to reserve strengths to make the backward movement a propellant one [as well], thereby significantly increasing the performance of this flipper.

[0016] In the traditionally neutral propulsive phase while the leg is being pulled up, the angular freedom allows placing the flipper blade in the flow thus eliminating any effort. With the claimed flipper it is possible, owing to the energy saved during the propellant phase, to transform, by stretching the feet, this rest phase into a propellant phase, increasing the performance even further.

[0017] The liberated propulsive force makes it possible to design a flipper with a stiffer blade than the current blades and with higher and longer side ribs, and intended to laterally stiffen the blade and to prevent it from twisting, but also to provide for better channeling of the laminar flow of the water and to enhance the phenomenon of pressure and depression.

[0018] The swimming and diving flipper as per invention presents thus the advantage of improved energy transmission (or mechanical work) of the leg/foot system group to the blade in an optimal manner by reinforcing the active push and by enhancing the passive return of the foot, while preserving the integrity of the articulation at the ankle, and by maintaining the freedom of the foot in the pull-up phases of the leg and for all the straightening actions of the foot (dorsal deflection of the foot).

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0019] The aforementioned goals, characteristics and advantages, and yet others, will become clearer in the following description and the attached drawings.

[0020] Figure 1 is an exploded perspective view of a first production example of a swimming and diving flipper according to invention.

[0021] Figure 2 is a perspective view of this flipper.

[0022] Figure 3 is a side elevation view and figure 4 a top view of it.

[0023] Figure 5A is a side elevation view showing the angle a formed by the instep and the lower part of the leg during the passive finning movement.

[0024] Figure 5B is a detailed sectional view of a production example of the limit stop system limiting the amplitude of the foot movement, shown during the passive finning movement.

[0025] Figure 6A is a side elevation view showing the angle a' formed by the instep and the lower part of the leg during the active finning movement.

[0026] Figure 6B is a detailed sectional view analog to figure 5B and shows the position of the stop system during the active finning phase.

[0027] Figure 7 is a partial perspective view at a magnified scale, illustrating the positioning of the flipper on the lower part of a leg.

[0028] Figure 8 is an exploded perspective view of a second production type of the swimming and diving flipper according to invention.

[0029] Figure 9 is a perspective view of a third production type of the swimming and diving flipper according to invention.

DETAILED DESCRIPTION OF THE INVENTION

[0030] Reference is made to these drawings to describe advantageous, but by no means limiting, production methods of the swimming and diving flipper according to invention.

[0031] Following the example shown in figures 1 to 4, the flipper includes a slip-in pocket or bootee 1 for encasing the user's foot. At the front, this bootee may be closed or open to let the user's toes protrude; at the back, the bootee may be closed or open and features an adjustable fastening system which allows fitting the flipper on feet of different size.

[0032] The bootee 1 is an integral part of the blade 2 which extends forward of the bootee, beginning at the sides of the bootee.

[0033] The blade may include side ribs 3 ensuring its stability and control of its deformation. It may also include a central rib (not shown). These longitudinal ribs also ensure a good flow of the water in direction of the trailing edge during the swimming movements.

[0034] The bootee 1 and the blade 2 can be made of any appropriate supple or semi-rigid material such as thermoplastic material.

[0035] The assembly consisting of the bootee 1-blade 2-lateral stiffeners 3 and any other longitudinal ribs may be realized by any convenient molding, depending on the material(s) selected to form the various parts of the flipper.

[0036] For example, the blade may be made of polypropylene, by an injection process, or may be made of carbon or glass fiber, etc.

[0037] The bootee 1 may be made of Kraton (registered trademark) with a duplicate molding technique by injection on the blade 2.

[0038] The bootee itself is made in the classic manner, i.e., it is shaped so as to allow, when it is positioned on a user's foot, a pivoting motion of the instep P with respect to the leg J, so that said instep can form, during use, an angle a of variable size with the leg.

[0039] The flipper includes limit stops, preferable adjustable, ensuring a limitation of the size of this angle to a value below that of the maximum anatomical angle the instep P can normally form with the leg J, without causing any pain to occur.

[0040] The means for limiting the amplitude of the pivoting movement of the foot during the active phase of the finning action is in the form of a complementary fitting of the propulsion assembly 1-2 and the lower extremity of side arms 4 connecting said propulsion assembly to a leg attachment device 5 that can be fastened around the user's leg.

[0041] The lower extremity of each side arm 4 is connected to the propulsion assembly 1-2 by a hinge 6.

[0042] The propulsion assembly 1-2 is equipped with lateral posts at each side of the bootee 1 and on which are fastened the lower extremities of the side arms 4, with the hinges 6. These lateral posts ensure the transmission of efforts between the side arms 4 and the blade 2; thanks to them this effort is prevented from passing through the ankle.

[0043] They may be made of polyacetals (Delrin: registered trademark) by an injection process, at the same time as the other components of the propulsion assembly 1-2.

[0044] The side arms 4 are intended to transmit the force generated by the finning movement from the leg fastening device 5 to the blade 2, by way of the side arms 7. They may be made of any suitable plastic material, such as for instance a polyacetal of the "Delrin" (registered trademark) in an injection process.

[0045] The lower parts 4a of the effort transmitting arms 4 are enclosed in a sleeve 7a formed by the rear portion of the posts 7.

[0046] The hinge of each arm 4 in the corresponding sleeve 7a is realized by an axis 8 through holes 7b and 4b which represent, respectively, said sleeve and the lower part 4a of said arm.

[0047] According to an important characteristic arrangement of the invention, the hinges 6 are so placed that they are located at the user's malleoli when the swimming and diving flipper is attached to the user's leg. More precisely, the swivel pin, regardless of the type of hinge, is within a circle of a 15 mm radius around the axis of the malleolus.

[0048] The system of stops limiting the amplitude of the pivoting motion of the propulsion assembly 1-2 in relation to the effort-transmitting arms 4 may consist of a transversal stop wall 7c placed at the lower part of the hinge sleeve 7a and against which the lower extremity in the form a nose 4c of the corresponding arm 4 will stop at the end of the active pivoting motion of the propulsion assembly 1-2.

[0049] However, according to another characteristic arrangement of the invention, the system of stops includes removable shims 9 that are shaped so they can be attached and stowed between the cheeks of the hinge sleeves 7a of the side posts 7.

[0050] The function of these removable and interchangeable shims 9 which can be supplied in different sizes or thicknesses and made of elastomer of polyurethane, is threefold:

- allow adjustment of the limit stop angle of the hinged arms 4 in order to adapt the size of this angle to the suppleness of each individual's ankle;

- soften the impact noise of the hinged arms reaching the limit stop; and

- serve as wear parts.

[0051] These interchangeable shims 9 are positioned between the transversal stop wall 7c and the extremity 4c of the lower part 4a of the effort-transmitting side arms, with any fastening device allowing their rapid installation and removal, for instance with screws or clips. The shims are preferably fastened against the inside face of the transversal stop wall 7c.

[0052] Owing to this system of shims the mobile propulsion assembly 1-2 reaches the limit stop before the maximum extension of the swimmer's ankle, said system allowing the transfer of energy between said leg and the propulsion assembly via the effort-transmitting arms 4 and the side posts 7.

[0053] The action of these shims allows optimal utilization of the propulsion assembly 1-2 and particularly the blade 2, without painful stress on the joints when the blade takes its bearing on the water mass in order to generate the propulsion. On the other hand, the pivoting is not limited by limit stops during the dorsal bending of the foot which corresponds to the foot's return during the passive

phase of finning. In this way the foot and the flipper offer little resistance to the fluid flow they pass through.

[0054] According to the production types illustrated in figures 1 to 8, the linkage between the side posts 7 and the effort-transmitting side arms 4 is established by a cylindrical hinge 6 including an axis 8; however, this linkage could be obtained by a hinge of another type which would allow a pivoting motion of the propulsion assembly 1-2 in relation to said effort-transmitting arms 4.

[0055] The leg-fastening device 5 can be in the form of a kind of collar composed of elements shaped so as to surround the lower part of a user's leg, below the calf, this device consisting for example of two support pieces 10 and 11, held together on the one hand by a supple tie 12 and on the other hand by a detachable connection system 13A-13B for opening and closing this collar.

[0056] One of the support pieces (or the back piece 10) is shaped to be placed as support around the back part of the leg and more precisely around the lower part of a user's leg, below the calf, so as not to rest on the muscle. The other support piece (or front piece 11) is shaped so that it comes into contact with the front part of the leg and more precisely with the user's tibia.

[0057] These ergonomically shaped support pieces which conform in shape, respectively, to the rear and lower part of the leg and that of the swimmer's tibia, are preferably made of a rigid thermoplastic material such as polypropylene for instance.

[0058] In order to make their pressure on the swimmer's leg more comfortable, the inner concave face of the leg support pieces 10 and 11 is advantageously provided with a lining or layer of soft material 10a, 11a respectively, made for instance out of a polyurethane elastomer. These soft linings ensure the spreading of the reaction forces over the entire contact area on the leg, particularly the pressure area of the front support piece 11 on the tibia.

[0059] According to the production types shown, the transmission arms 4 are made from a single piece and are attached to each other at their upper part and in the back by a piece that is the rear support piece 10 of the leg fastening device 5.

[0060] In this case, the soft tie 12 connecting the rear and front support pieces 10 and 11 respectively of the leg fastening device 5, can consist of a strap that is attached so that it in one or several slots 14 that are present on said pieces on their outside. One of the ends of this strap may be equipped with notches 13A while the other end of the strap may feature a quick-fastening buckle 13B.

[0061] The swimming and diving flipper shown in figure 8 differs from the one that has just been described, primarily due to the fact that the propulsion assembly 1-2 consists of a traditional swimming flipper as is currently available on the market, completed by the previously described means that are proper to the invention.

[0062] In this case the side posts 7 are not molded at the same time as the bootee 1 and the blade 2, but are pieced on said propulsion assembly by any appropriate process. For this purpose the side posts 7 consist of a piece which features a U-shaped cross section according to which said side posts are linked by a sole plate 7d by which said piece is attached under the propulsion assembly 1-2 at the level of the bootee, by any suitable process.

[0063] The swimming and diving flipper shown in figure 9 differs from the preceding ones in so far as its bootee 1, its blade 2, its effort-transmitting arms 4 and at least the rear support piece 10 of its leg-fastening device 5, are all of one piece. In this case the rear support piece 10 is arranged in a manner so as to constitute a limit stop against which against which the backside of the user's leg comes to rest, so that the leg at the end of the active finning phase can form with the instep only an angle of limited size, smaller than the size of the maximum anatomical angle.